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PUREX PLANT DEACTIVATION

MISSION ANALYSIS REPORT

March 30, 1995

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DISCLAIMER

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of the PUREX Deactivation Project mission analysis is to define the problem to be addressed by the PUREX mission, and to lay the ground work for further system definition. The mission analysis is an important first step in the System Engineering (SE) process. This report presents the results of the PUREX Deactivation Project mission analysis.

The PUREX functions and requirements to successfully accomplish this mission, the selected alternatives and products will later be defined using the SE process.

1.2 BACKGROUND

PUREX was a nuclear fuel processing plant used to chemically separate plutonium and uranium from Hanford Site nuclear reactor fuel elements. The plant was constructed between 1953 and 1955 and was operated intermittently until 1990. In October 1990, DOE-Richland Operations Office (RL) directed Westinghouse Hanford Company (WHC) to initiate transition-to-standby activities for PUREX. The standby condition was achieved in September 1992. In December 1992, the DOE Assistant Secretary for Environmental Restoration and Waste Management authorized termination of PUREX. (See WHC-MR-0437, " A Brief History of the PUREX and UO3 Facilities", M.S. Gerber).

1.3 MISSION SCOPE

The scope of the PUREX Plant deactivation mission is defined in the PUREX DPMP. Section 2 of this report examines in greater detail mission objectives, initial conditions, final conditions, constraints, resources and interfaces necessary to successfully complete the PUREX Plant deactivation mission. A high level summary of the PUREX mission scope includes:

- Deactivation of the PUREX plant, ancillary support structures, PUREX mobile offices, KEH mobile offices, plant utilities, and underground radioactive waste and effluent lines within the PUREX fence. (The project's physical boundaries are generally defined by the surrounding fenceline surrounding the PUREX facility.) The only significant ancillary support structure beyond the fenceline that will also be deactivated is the 216-A-42 retention basin. The activities identified in the PUREX DPMP and PUREX Deactivation End Point Criteria (DEPC), WHC-SD-WM-TPP-053, Rev. 0 describe what needs to be done to deactivate PUREX and its ancillary support structures.

- Facilities outside the fence will be turned back over to the Site Landlord when they are no longer needed.

1.4 MISSION STATEMENT

The purpose of the PUREX Deactivation Project is to prepare PUREX for Decontamination and Decommissioning (D&D) within a five year time frame. This will be accomplished by establishing a passively safe and environmentally secure configuration of the PUREX Plant, that can be preserved for a 10-year horizon. During deactivation, appropriate portions of the safety envelop will be maintained to ensure deactivation takes place in a safe and regulatory compliant manner. Stakeholders will be actively involved during deactivation.

2.0 MISSION ANALYSIS

2.1 PUREX PROBLEM STATEMENT

PUREX has no future mission, and is expensive to maintain in its current configuration. Nuclear, radioactive and hazardous materials are not currently in an acceptable configuration for turn over to Environmental Restoration (ER). PUREX must be deactivated to a point where only minimal maintenance and surveillance is required to maintain the facility for 10 years or more while awaiting D&D and safe and compliant D&D operations can take place.

2.2 PROJECT OBJECTIVES

- Establish a passively safe and environmentally secure configuration of the plant, and retain that configuration for a 10-year horizon.
- Ensure worker health and safety throughout the deactivation. Maintain a high degree of emphasis toward worker health and safety by applying a graded approach to implementing safety controls, providing adequate worker training and a strong emphasis on conduct of operations.
- Achieve a total surveillance and maintenance (S&M) yearly cost target of $2 to $5 million/year at turnover to D&D.
- Implement cost-effective, innovative approaches to ensure the required safety envelope is defined and maintained during deactivation.
- Comply with Environmental, Safety, and Health codes and standards during deactivation.
- Involve stakeholders in the development and execution of the PUREX Deactivation Project.
- Transition the workforce out of PUREX through redeployment or outplacement.
- Apply lessons learned from commercial deactivation experience.
- Establish the PUREX Deactivation Project as a model for canyon facility deactivations.

2.3 MISSION DEFINITION

In addition to the mission statement, the mission to deactivate PUREX can be further defined through an understanding of the initial conditions

prior to deactivation, the final end point or conditions desired upon completion of the mission, the constraints under which the mission must be performed, and the resources that are available to enable the mission. The following paragraphs describe the initial and final conditions, the physical boundaries and programmatic interfaces, and the resources to achieve PUREX deactivation. A diagram of the initial conditions, final conditions, constraints and resources required to perform the PUREX Deactivation Mission are shown in Figure 1.

2.3.1 INITIAL CONDITIONS

LEGACY FACILITIES, EQUIPMENT AND NON-NUCLEAR MATERIALS

The following facilities, equipment and non-nuclear materials are included in addition to the PUREX Plant: ancillary support structures; PUREX mobile offices; KEH mobile offices; plant utilities; chemical inventory in process facilities; hazardous materials; and underground effluent lines within the PUREX fence.

A comprehensive list of facilities, equipment and non-nuclear materials and their initial state are discussed in the PUREX DPMP.

LEGACY NUCLEAR MATERIALS

The following legacy nuclear materials are included: single-pass reactor fuel; N Reactor fuel; zirconium cladding containing fuel residuals; plutonium-uranium solution; contaminated solvents; plutonium dioxide; radiologically contaminated equipment; and contaminated acid.

Quantification of nuclear materials and their initial state are discussed in the PUREX DPMP.

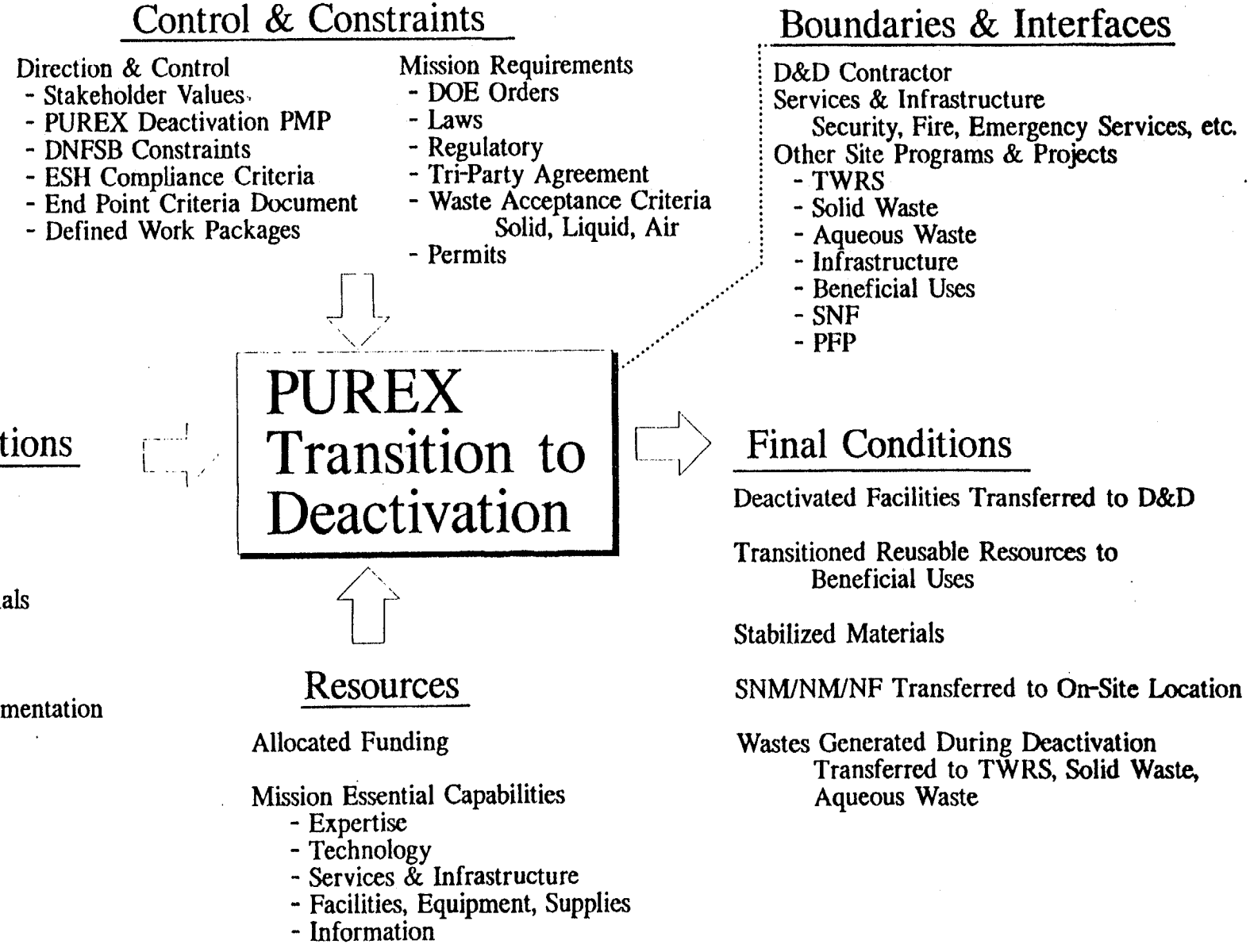
2.3.2 FINAL CONDITIONS

DEACTIVATED FACILITY(s)

Deactivated facilities include the PUREX Plant, ancillary buildings, and mobile offices inside the PUREX fenceline. The mobile offices and ancillary buildings are divided into seven categories. The categories are as follows: Category 1, buildings with radiological and chemical concerns; Category 2, buildings with chemical concerns only; Category 3, buildings with radiological concerns only; Category 4, buildings with liquid effluents; Category 5, buildings with gaseous effluents; Category 6, clean buildings; and Category 7, operable buildings.

The PUREX DPMP and DEPC describe what needs to be done to deactivate PUREX and its ancillary support structures. Deactivated facilities are transferred to the Environmental Restoration activity for D&D. In some cases, it may take years

Figure 1. PUREX Mission Context Diagram



before D&D can occur, making it essential that the facilities be placed in a safe, stable and environmentally compliant condition that requires minimal maintenance and surveillance and results in an unoccupied facility status.

The PUREX DPMP contains the recommended overall end point for the PUREX deactivation. Negotiations are in process to define a specific end point acceptable to D&D.

ON-SITE NUCLEAR MATERIALS

Nuclear materials must be either removed, treated and/or stabilized. Nuclear materials that must be considered for removal include: single-pass reactor fuel; N Reactor fuel; zirconium cladding containing fuel residuals; slightly radioactively contaminated solvents; radioactively contaminated nitric acid; and plutonium-uranium metal solutions. The single-pass reactor fuel and N reactor fuel could go to the 100 K-East Basin. The metal solution could be treated and sent to Tank Farms.

The PUREX DPMP contains the recommended end point for the PUREX deactivation. Negotiations are in process to define an endpoint acceptable to D&D.

WASTES GENERATED DURING DEACTIVATION

Wastes generated during deactivation include: radioactively contaminated effluents; transuranic waste (TRU) (i.e., plutonium nitrate from PR room, plutonium from N Cell and neptunium from Q Cell); and non-radioactively contaminated effluents. Contaminated effluents go to the tank farms, TRU goes to solid waste, and effluents will go to effluent treatment facilities.

The PUREX DPMP identifies and quantifies the amount of each waste type expected as a result of deactivation activities.

2.3.3 CONSTRAINTS

DEFINED WORK PACKAGES

The PUREX DPMP and DEPC describe what transition activities will be performed to deactivate PUREX and its associated ancillary facilities and structures. Work Plans are created to capture various portions of the planned work scope, and when used in conjunction with approved Plant Procedures, define how the various activities will be performed. All activities requiring craft support have work packages prepared and placed into the PUREX Job Control System.

DIRECTION AND CONTROL

Direction and control is provided from the Manage function, which is described in WHC-EP-0722, "Systems Engineering Functions and Requirements for the Hanford Cleanup Mission: First Issue". Direction is generally provided at a program level. The Manage function must integrate all program and project efforts and make site level decisions to achieve the best overall results at the site level.

MISSION REQUIREMENTS

Mission requirements are physical limits on system design solutions imposed from authority internal or external to the cleanup mission.

Mission constraints that are internally (self) imposed upon the cleanup mission are as follows:

- Design solutions must inherently improve the safety posture of the site with respect to subsequent operations.
- Only cost effective design solutions will be considered.
- Stakeholder interests must be included in alternative definition and selection.
- Successful alternatives must be capable of resulting in, or contributing to, the rapid progress needed to sustain mission momentum and support.
- The cleanup work must not adversely affect other ongoing or projected Hanford Site missions.
- The PUREX Plant configuration shall be modified and controlled sufficiently to enable safety and regulatory compliance during deactivation. Records shall be established and archived for reactivating D&D essential systems and providing meaningful D&D characterization information. Configuration Management during deactivation shall be in accordance with requirements established in WHC-SD-HT-RPT-001, Rev.0, "WHC Uniform Configuration Management Approach for Deactivation of Transition Projects".
- Hazardous and radioactive materials shall be removed from the facilities or stabilized sufficiently to allow a reduction in the hazard classification of the facility where feasible and ensure long-term safety and regulatory compliance, enable facility classification as non-occupied, and enable subsequent successful D&D.

Materials shall be removed and/or stabilized sufficiently to ensure that the plant complies with DOE-N-5480.6, Hanford Site Radiological Control Manual, as applicable to a non-occupied facility. Materials shall also be removed where plant knowledge and expertise is necessary to ensure safe and compliant removal.

- Final facility configuration shall ensure D&D operations are not jeopardized, and facility safety and environmental protection can be maintained until D&D.

- To achieve a non-occupied facility status, the following actions shall be performed:

  - Ventilation and monitoring equipment shall be consolidated, relocated, housed, operated, and/or maintained such that facility entry frequency does not compromise the non-occupancy status.

  - Fire protection systems shall be modified or eliminated to minimize system testing and maintenance and to reflect the non-occupied status.

  - Electrical and water supply services to the process buildings shall be isolated; electrical and water supply services in the surrounding yard areas shall be reduced to meet minimum surveillance and maintenance requirements. Centralized services shall be considered.

  - The building steam system shall be deactivated, requiring building steam requirements to be eliminated.

  - At completion of deactivation, the facilities will be unoccupied, locked and maintained with minimum entry requirements.

On a broad level, mission requirements consist of compliance with the following:

- Public Law (PL); these are federal legislative statutory laws that are generated by a specific session of Congress. The National Defense Authorization Report in connection with the permanent closure of DOE Defense Nuclear Facilities is an example of one applicable PL.

- United States Code (USC); these are laws of a general and permanent nature under arrangement of official code of laws of the United States. Examples include: Clean Water Act; National Environmental Policy Act; Resource Conservation and Recover Act of 1976; Comprehensive Environmental Response, Compensation, and Liability Act of 1980; and the Nuclear Waste Policy Act.

- Federal Register (FR); these include, but are not limited to, proposed and final federal agency regulations, policies, documents required to be published by an act of Congress and other federal agency documents of public interest. The Final Environmental Impact Statement for the Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington: Decision of Records is an example of a FR document.

- Code of Federal Regulations (CFR); these are a codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government. Examples include: Packaging and Transportation of Radioactive Material; Occupational Safety and Health Administration; Identification and Listing of Hazardous Waste; Standards Applicable to Generators of Hazardous Waste; and Shippers-General Requirements for Shipments and Packaging.

- Hanford Federal Facility Agreement and Consent Order (89-10, Rev. 1); this is the agreement between DOE, EPA, and the Washington State Department of Ecology and is more commonly known as the Tri-Party Agreement. The Tri-Party Agreement identifies milestones that quantify actions toward Hanford Site compliance with the Resource Conservation and Recovery Act of 1976, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, and the Washington State Hazardous Waste Management Act.

- Washington Administrative Code (WAC); these are a codification of general and permanent rules published in the Washington State Register by the agencies of the State of Washington. Examples include: Dangerous Waste Regulations; Washington Ambient Air Quality Standards and Emission Limits for Radionuclides; Washington Standard for Protection Against Radiation; and Transportation of Hazardous Materials.

- Revised Code of Washington (RCW); comprises all laws of a general and permanent nature under arrangement of official code of laws of the State of Washington. Examples include: Washington State Environmental Policy Act; Washington Radioactive Waste Act; Washington Industrial Safety and Health Act; and Washington Clean Air Act.

- Executive Order (EO); these are orders or regulations issued by the President, or administrative authority, that can have the effect of law if published in the Federal Register. Responses to Environmental Standards (Aug. 14, 1981; 46 FR 42237) and Superfund Implementation (Feb. 23, 1987; 52 FR 2923) are examples of EOs.

- Secretary of Energy Notices (SEN); these convey direction on processes and procedures which control operations, design, procurements, etc.. SEN-35-91, Nuclear Safety Policy is an example of a SEN.

- U.S. Department of Energy Orders; these are long-lasting directives stating policy or establishing standards of operation. Examples of DOE Orders include: Comprehensive Environmental Response, Compensation, and Liability Act Requirements; Radiation Protection of the Public and the Environment; National Environmental Policy Act Compliance Program; Environmental Protection, Safety and Health Protection Standards; and Radiation Protection for Occupational Workers.

- U.S. Department of Energy Notices; these are one-time or short-term (less than 1 year) instructions or information. Notices are used to provide immediate dissemination until the information can be incorporated into an order.

- Codes and Standards; these are national or international consensus documents written and critiqued by technical specialists versed in the field of interest. Usually these standards are generated by professional societies.

- U.S. Department of Energy Environmental Management Policy; these are guidelines formulated by the Assistant Secretary for Environmental Management or by the Secretary of Energy.

- Westinghouse Hanford Company Controlled Manuals; these are internal company procedures that are intended to encompass all relevant requirements associated with activities covered in the procedure and describe how the activities need to be performed to ensure compliance. Examples include WHC-CM-4-3, Industrial Safety Manual, etc. . .

2.3.4 MISSION BOUNDARIES, ENVIRONMENT AND INTERFACES

2.3.4.1 Mission Boundaries

The project's physical boundaries are generally defined by the fence line surrounding the PUREX complex. The only significant ancillary support structure beyond the fence line that will also be deactivated is the 216-A-42 retention basin.

The programmatic boundaries of PUREX are organizational rather than physical. Examining the interfaces where information, material or energy are exchanged provides additional insight. PUREX consists of approximately 300 personnel involved in activities to complete the deactivation mission. For example the PUREX personnel interface with the following areas and functions:

- Site utilities (sewage, steam, water, electricity)
- Site security, transportation, and custodial services
- Fire protection
- Waste management
- Solid waste

2.3.4.2 Mission Environment

The mission environment is defined as that which exists outside of the PUREX mission. How this environment is expected to change or remain the same throughout the life of the mission is important in defining the mission. The Relevant attributes of the environment are listed below:

- DOE is expected to use the Hanford Cleanup as its model for environmental restoration. Therefore, DOE is expected to be closely involved in the process, and the funding is expected to be adequate.
- PUREX has taken an active role to get the public involved and to share information.
- The management of the Hanford Site Cleanup Mission will be strengthened and will supply the policy, procedures, and resources to effectively cleanup Hanford.

2.3.4.3 External Interfaces

These interfaces are those entities through which the mission receives or transfers information, material or energy outside of the defined mission including external requirement sources. The following are interfaces related to the PUREX mission:

- Federal Agencies
- State and Local Governments
- Confederated Tribes
- DOE Headquarters and Field Office
- DOE Laboratories
- Other Hanford Programs and Projects
  - Spent Nuclear Fuel Project
  - TWRS Program
  - Solid Waste Program

- Aqueous Waste Project
- Site Environmental Monitoring
- Site Infrastructure

- Environmental Restoration (ER) Contractor
- Stakeholders
- Other facilities in DOE complex

2.3.5 RESOURCES

ALLOCATED RESOURCES

Allocated resources primarily includes the budget and personnel necessary to carry out the current fiscal technical baseline defined by the Manage function, which is described in WHC-EP-0722, "Systems Engineering Functions and Requirements for the Hanford Cleanup Mission: First Issue".

MISSION ESSENTIAL CAPABILITIES

Mission essential capabilities include the expertise, facilities, equipment, infrastructure, supplies, information, services and technology to perform the PUREX Deactivation Project. Typically, these are provided by the Acquire Mission Essential Capabilities function, which is described in WHC-EP-0722, "Systems Engineering Functions and Requirements for the Hanford Cleanup Mission: First Issue".

2.4 MISSION EVALUATION

2.4.1 MISSION RISK AREAS/FACTORS

- The PUREX DPMP includes mission risk areas/factors. Changes to any of the assumptions made in the PUREX DPMP will result in risk to mission execution.

2.4.2 MEASURES OF EFFECTIVENESS

- How well project objectives are met.
- Timely identification of potentially transferrable resources.
- Timely identification of deactivation needs.
- The reduction of surveillance and maintenance costs upon completion of deactivation.

3.0 REFERENCES

9452199; March 29, 1994; Hanford Site Systems Engineering Management Plan; Westinghouse Hanford Company.

9453650; May 25, 1994; Hanford Site Systems Engineering Manual; Westinghouse Hanford Company.

WHC-EP-0722 Rev. 0; January 1994; Systems Engineering Functions and Requirements for the Hanford Cleanup Mission: First Issue; Westinghouse Hanford Company.

WHC-SP-1011 Rev. 0; August 1994; PUREX/UO3 Deactivation Project Management Plan; Westinghouse Hanford Company.

WHC-MR-0437, " A Brief History of the PUREX and UO3 Facilities", M.S. Gerber

WHC-SD-WM-TPP-053, Rev. 0, PUREX Deactivation End Point Criteria; Westinghouse Hanford Company.

WHC-SD-HT-RPT-001, Rev. 0; WHC Uniform Configuration Management Approach for Deactivation of Transition Projects; Westinghouse Hanford Company.

4.0 GLOSSARY

This section contains the definition of words and phrases found in the text of this document.

active	This term describes the operational status of a process or facility. When a facility is active, it is currently operating or scheduled for operation.
deactivation	The transition of facilities to a state where the buildings, chemical processing systems and infrastructure are placed in a long term, low cost, minimum surveillance and maintenance, safe condition and are ready for D&D. A facility enters deactivation when the need for a facility to fulfill its current mission does not exist.
D&D	D&D is decontamination and decommissioning and is performed when no other missions are identified. The objective of D&D is to place the site in a long-term radiologically safe condition. Dismantling and decontamination, mothball for later dismantlement and entombment are all D&D options.
ER	ER is Environmental Restoration. It is an activity contracted to the ER Contractor. They will perform D&D of facilities.
infrastructure (facility)	Facility infrastructure is the physical portions of the facility which are implicit to the function of the activities in the structure, such as the heating ventilation, electricity etc.
infrastructure (site)	Includes all utility, support and other service systems that interfere with a particular facility complex. Within a facility complex ancillary facilities and structures provide infrastructure support to the main facility.
mission	A mission is a narrative description of the ultimate goals and highest purpose for an organizational unit, facility or project.
stabilize	This is the process of treating (chemically or physically) material to make it less hazardous.
standby	This term describes the operational status of a process or facility. A facility in standby is not currently operating, but it is operable after appropriate startup checks and testing have been performed. In some cases appropriate repairs and upgrades may be necessary.

turnover	Turnover is the transaction which transfers responsibility from the current organizational unit (Transition Projects) to the ER contractor.